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PATENT

IN THE UNITED STATES DESIGNATED OFFICE (DO/US)

PCT/JP01/00872  
INTERNATIONAL APPLICATION NO.

8 February 2001  
INTERNATIONAL FILING DATE

9 February 2000  
PRIORITY DATE CLAIMED

TITLE OF INVENTION

LITHIUM SECONDARY BATTERY AND MANUFACTURING METHOD THEREOF

APPLICANT(S) FOR DO/US

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Attention: DO/US

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*Elizabeth A. VanAntwerp*  
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PRELIMINARY AMENDMENT

Sir:

Prior to examination, Applicants wish to amend the subject application as follows:

In the Claims:

Please rewrite claims 3-7, 11-15, 17, 18, 20, 23 and 27 as follows:

3. (Amended) The lithium secondary battery according to claim 1, wherein, with a difference between said  $R_{\text{body}}$  (mm) and said  $R_{\text{top}}$  (mm) being  $\Delta R$ (mm),  $\Delta R$  fulfills relationship of  $\Delta R \leq 5$ (mm).
4. (Amended) The lithium secondary battery according to claim 3, wherein said  $R_{\text{body}}$  and said  $\Delta R$  fulfill a relationship of  $(\Delta R/R_{\text{body}}) \times 100 \leq 10$ (%).
5. (Amended) The lithium secondary battery according to claim 1, wherein, with said caulked portion, a deformation quantity in a press-contacting direction of said press-contacted

elastic body is larger than a spring-back quantity and a press-contact force applied to said elastic body is not more than a press-contact force with elasticity maintaining rate of said elastic body being not less than 95%.

6. (Amended) The lithium secondary battery according to claim 1, wherein said elastic body is made of any of ethylene propylene rubber, polyethylene, polypropylene and fluororesin.

7. (Amended) The lithium secondary battery according to claim 1, wherein said electrode cap comprises an electrolyte solution injection port.

11. (Amended) The lithium secondary battery according to claim 9, wherein said battery cap and said external terminal are made of Al or Al alloy.

12. (Amended) The lithium secondary battery according to claim 9, wherein, with a difference between said  $R_{\text{body}}$  (mm) and said  $R_{\text{top}}$  (mm) being  $\Delta R$ (mm),  $\Delta R$  preferably fulfills relationship of  $\Delta R \leq 5$ (mm).

13. (Amended) The lithium secondary battery according to claim 12, wherein said  $R_{\text{body}}$  and said  $\Delta R$  fulfill relationship of  $(\Delta R/R_{\text{body}}) \times 100 \leq 10$ (%).

14. (Amended) The lithium secondary battery according to claim 8, wherein said battery case is shaped as a pipe.

15. (Amended) The lithium secondary battery according to claim 8, wherein entire area of said tip portions of said battery case and said electrode cap are joined by said welding.

17. (Amended) The lithium secondary battery according to claim 1, wherein battery capacity is 2 Ah or more.

18. (Amended) The lithium secondary battery according to claim 1 to be mounted on a vehicle.

20. (Amended) The lithium secondary battery according to claim 18 for an electric vehicle or a hybrid electric vehicle.

23. (Amended) The manufacturing method of a lithium secondary battery according to claim 21, wherein a caulking and/or welding method is used as a method for joining said battery case and said electrode cap.

27. (Amended) The manufacturing method of a lithium secondary battery according to claim 21, wherein, as said battery case, one made of aluminum or aluminum alloy is used.

Please add new claims 28 and 29 as follows:

28. (Amended) The lithium secondary battery according to claim 9, wherein said battery case is shaped as a pipe.

29. (Amended) The lithium secondary battery according to claim 9, wherein entire area of said tip portions of said battery case and said electrode cap are joined by said welding.

**In the Abstract:**

**Please rewrite the abstract as follows:**

**Abstract of the Disclosure**

A lithium secondary battery, includes: a cylindrical battery case (16) provided with electrode caps at both end portions thereof; an electrode body (1) impregnated with a nonaqueous electrolyte solution and contained in the battery case and including a positive electrode, a negative electrode, and a separator, the positive electrode and the negative electrode being wound or laminated through the separator; and an elastic body (23) disposed between the battery case (16) and the electrode caps with portions in which the battery case (16) contacts the elastic body (23) being brought into press-contact to form a caulked portion to seal the battery case (16). With  $R_{\text{body}}$  (mm) being the diameter of a body part of the battery case (16) and  $R_{\text{top}}$  (mm) being the diameter of the caulked portion,  $R_{\text{body}}$  and  $R_{\text{top}}$  fulfill the relationship of  $R_{\text{body}} > R_{\text{top}}$ .

**REMARKS**

Claims 1-29 are pending herein. Applicants have amended the claims to eliminate multiple dependent claims. New claims 28 and 29 have been added hereby. No new matter has been added. Applicants believe the case is now in condition for examination.

Attached hereto captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE" is a marked-up version of the changes made to the claims and abstract by the current amendment.

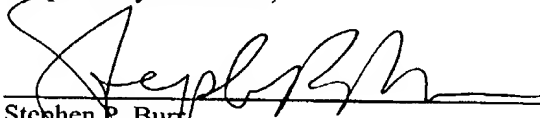
If the Examiner believes that contact with applicants' attorney would be advantageous toward the disposition of this case, he is herein requested to call applicants' attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446.

October 2, 2001

Date

Respectfully submitted,

  
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**VERSION WITH MARKINGS TO SHOW CHANGES MADE**

**In the Claims:**

Claims 3-7, 11-15, 17, 18, 20, 23 and 27 have been amended as follows:

3. (Amended) The lithium secondary battery according to claim 1-~~or~~2, wherein, with a difference between said  $R_{\text{body}}$  (mm) and said  $R_{\text{top}}$  (mm) being  $\Delta R$ (mm),  $\Delta R$  fulfills relationship of  $\Delta R \leq 5$ (mm).
4. (Amended) The lithium secondary battery according to ~~any one of~~ claims 1 to 3, wherein said  $R_{\text{body}}$  and said  $\Delta R$  fulfill a relationship of  $(\Delta R/R_{\text{body}}) \times 100 \leq 10$ (%).
5. (Amended) The lithium secondary battery according to ~~any one of~~ claims 1 to 4, wherein, with said caulked portion, a deformation quantity in a press-contacting direction of said press-contacted elastic body is larger than a spring-back quantity and a press-contact force applied to said elastic body is not more than a press-contact force with elasticity maintaining rate of said elastic body being not less than 95%.
6. (Amended) The lithium secondary battery according to ~~any one of~~ claims 1 to 5, wherein said elastic body is made of any of ethylene propylene rubber, polyethylene, polypropylene and fluoro-resin.
7. (Amended) The lithium secondary battery according to ~~any one of~~ claims 1 to 6, wherein said electrode cap comprises an electrolyte solution injection port.
11. (Amended) The lithium secondary battery according to claim 9-~~or~~10, wherein said battery cap and said external terminal are made of Al or Al alloy.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

12. (Amended) The lithium secondary battery according to ~~any one of~~ claims 9 ~~to~~ 11, wherein, with a difference between said  $R_{\text{body}}$  (mm) and said  $R_{\text{top}}$  (mm) being  $\Delta R$  (mm),  $\Delta R$  preferably fulfills relationship of  $\Delta R \leq 5$  (mm).

13. (Amended) The lithium secondary battery according to ~~any one of~~ claims 9 ~~to~~ 12, wherein said  $R_{\text{body}}$  and said  $\Delta R$  fulfill relationship of  $(\Delta R/R_{\text{body}}) \times 100 \leq 10$  (%).

14. (Amended) The lithium secondary battery according to ~~any one of~~ claims 8 ~~to~~ 13, wherein said battery case is shaped as a pipe.

15. (Amended) The lithium secondary battery according to ~~any one of~~ claims 8 ~~to~~ 14, wherein entire area of said tip portions of said battery case and said electrode cap are joined by said welding.

17. (Amended) The lithium secondary battery according to ~~any one of~~ claims 1 ~~to~~ 16, wherein battery capacity is 2 Ah or more.

18. (Amended) The lithium secondary battery according to ~~any one of~~ claims 1 ~~to~~ 17 to be mounted on a vehicle.

20. (Amended) The lithium secondary battery according to claim 18 ~~or~~ 19 for an electric vehicle or a hybrid electric vehicle.

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**VERSION WITH MARKINGS TO SHOW CHANGES MADE**

23. (Amended) The manufacturing method of a lithium secondary battery according to claim 21 ~~or~~ 22, wherein a caulking and/or welding method is used as a method for joining said battery case and said electrode cap.

27. (Amended) The manufacturing method of a lithium secondary battery according to ~~any one of~~ claims 21 ~~to~~ 26, wherein, as said battery case, one made of aluminum or aluminum alloy is used.

**In the Abstract:**

**The abstract has been amended as follows:**

**Abstract of the Disclosure**

A lithium secondary battery, includes: a cylindrical battery case (16) provided with electrode caps at both end portions thereof; an electrode body (1) impregnated with a nonaqueous electrolyte solution and contained in the battery case and including a positive electrode, a negative electrode, and a separator, the positive electrode and the negative electrode being wound or laminated through the separator; and ~~moreover,~~ an elastic body (23) disposed between the battery case (16) and the electrode caps with portions in which the battery case (16) contacts the elastic body (23) being brought into press-contact to form a caulked portion to seal the battery case (16). With  $R_{body}$  (mm) being the diameter of a body part of the battery case (16), and  $R_{top}$  (mm) being the diameter of the caulked portion,  $R_{body}$  and  $R_{top}$  fulfill the relationship of  $R_{body} > R_{top}$ . ~~Improvement in long period stability and reliability can be planned by intensifying the caulking between the battery case and the~~



electrode cap and by removing the caulked gap between the battery case and the electrode cap so as to suppress leakage of the electrolyte solution.

SECRET